Geophysical Research Abstracts
Vol. 19, EGU2017-14591-1, 2017
EGU General Assembly 2017

Automatic detection of avalanches in seismic data using Hidden Markov Models

Matthias Heck (1), Conny Hammer (2), Alec van Herwijnen (1), Jürg Schweizer (1), and Donat Fäh (2)

(1) WSL Institute for Snow and Avalanche Research SLF, Davos, Switzerland, (2) Swiss Seismological Service (SED), ETH Zürich, Zürich, Switzerland

Seismic monitoring systems are well suited for the remote detection of mass movements, such as landslides, rockfalls and debris flows. For snow avalanches, this has been known since the 1970s and seismic monitoring could potentially provide valuable information for avalanche forecasting. We thus explored continuous seismic data from a string of vertical component geophones in an avalanche starting zone above Davos, Switzerland. The overall goal is to automatically detect avalanches with a Hidden Markov Model (HMM), a statistical pattern recognition tool widely used for speech recognition. A HMM uses a classifier to determine the likelihood that input objects belong to a finite number of classes. These classes are obtained by learning a multidimensional Gaussian mixture model representation of the overall observable feature space. This model is then used to derive the HMM parameters for avalanche waveforms using a single training sample to build the final classifier. We classified data from the winter seasons of 2010 and compared the results to several hundred avalanches manually identified in the seismic data.
First results of a classification of a single day have shown, that the model is good in terms of probability of detection while having a relatively low false alarm rate.
We further implemented a voting based classification approach to neglect events detected only by one sensor to further improve the model performance. For instance, on 22 March 2010, a day with particular high avalanche activity, 17 avalanches were positively identified by at least three sensors with no false alarms.
These results show, that the automatic detection of avalanches in seismic data is feasible, bringing us one step closer to implementing seismic monitoring system in operational forecasting.